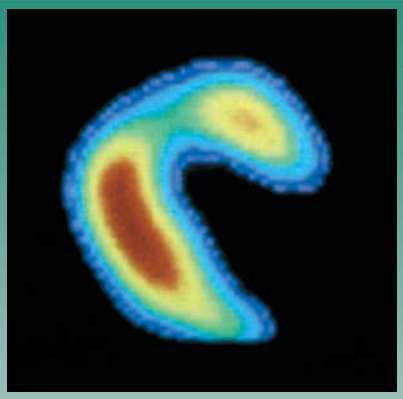
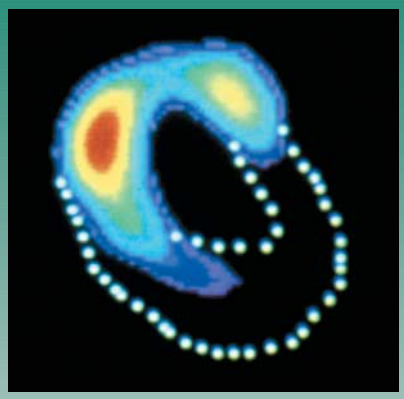
HOW DOES IT WORK?

Positron emission tomography



Heart muscle with good blood flow



Scan indicates restricted blood flow (causing the pain of angina)

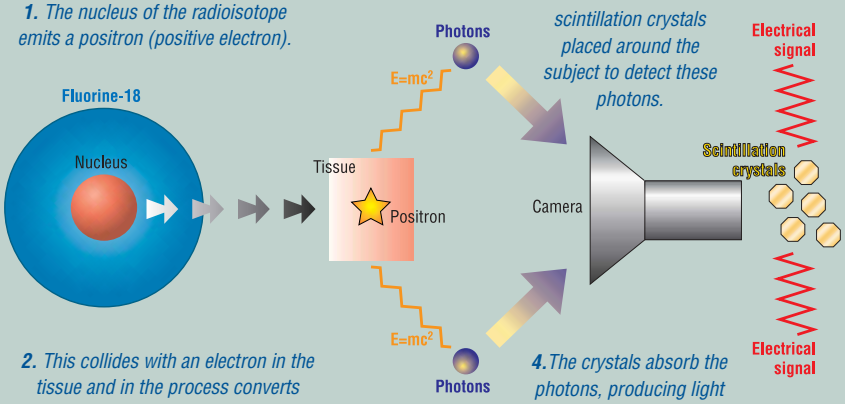
Gould and Deanza, Peter Arnold Inc/SPL

• Positron emission tomography (PET) is a technique that measures physiological function by looking at blood flow, metabolism, neurotransmitters, and radiolabelled drugs. PET offers quantitative analyses, allowing relative changes over time to be monitored as a disease process evolves or in response to a specific stimulus.

• The technique is based on the detection of radioactivity emitted after a small amount of a radioactive tracer is injected into a peripheral vein. The tracer is administered as an intravenous injection usually labelled with oxygen-15, fluorine-18, carbon-11, or nitrogen-13. The total radioactive dose is similar to the dose used in computed tomography.

• PET scans take 10-40 minutes to complete. They are painless, and, as for computed tomography, the patient is fully clothed.

• A common use for PET is to measure the rate of consumption of glucose in different parts of the body.



1. *The nucleus of the radioisotope emits a positron (positive electron).*

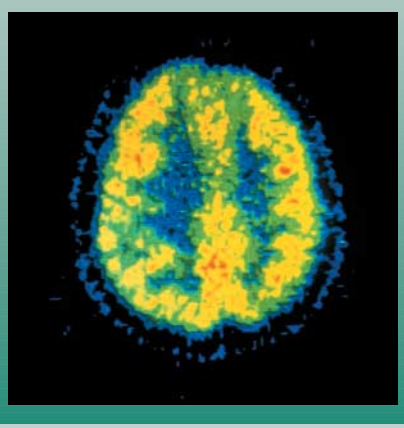
2. *This collides with an electron in the tissue and in the process converts mass to energy ($E=mc^2$) in the form of two photons.*

3. *The PET camera uses scintillation crystals placed around the subject to detect these photons.*

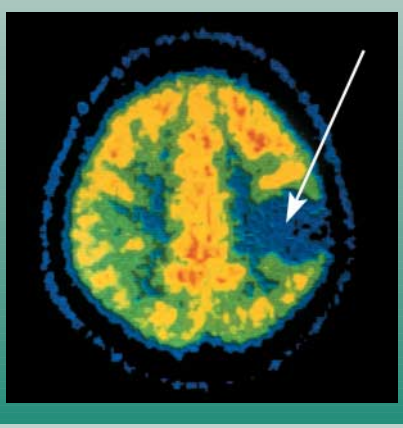
4. *The crystals absorb the photons, producing light that is converted into an electrical signal.*

• Accumulation of the radiolabelled glucose analogue 18-fluorodeoxyglucose (FDG) allows measurement of the rate of consumption of glucose. One clinical use of this is to distinguish between benign and malignant tumours (malignant tumours metabolise glucose at a faster rate than benign tumours). Whole body scans are often performed to stage a cancer.

Normal brain



A brain tumour demonstrated on the right (blue, indicating poor blood flow at the area of tissue damage or tissue death)



National Cancer Institute/SPL

• Other applications of PET include looking at the blood flow and oxygen consumption in different parts of the brain–for example, in understanding strokes and dementia. Tracking chemical neurotransmitters (such as dopamine, in Parkinson's disease) can also be performed with this technique.

• PET has further applications in cardiology (in pretransplantation assessment of viable myocardium), in distinguishing recurrent tumours from radiation necrosis and surgical scarring, and in a variety of cancers.

Further reading: *Positron Emission Tomography: Principles & Practice*, edited by Valk, Bailey, Townsend, and Maisey. London: Springer-Verlag, 2002 (ISBN 1-85233-485-1)

Abi Berger, *science editor, BMJ*